

Claim 55 recites “[a] container capacitor comprising: a lower electrode provided within a first insulating layer, said lower electrode comprising an electropolished patterned metal layer having a bottom wall and vertical sidewalls extending rectangularly upwardly therefrom; a second insulating layer provided over said electropolished patterned metal layer and in contact with said first insulating layer; and an upper electrode provided over said second insulating layer.”

Claim 60 recites “[a] container capacitor structure comprising: an insulating layer provided over a substrate; a plurality of rectangular openings provided in said insulating layer; a plurality of lower capacitor electrodes provided along the bottom and sidewalls of respective ones of said rectangular openings, said lower electrodes being formed as discrete electropolished metal layers; and a dielectric layer associated with each of said discrete lower electrodes, said dielectric layer being in contact with said insulating layer.” Applicant respectfully submits that neither Xing nor Aoki, whether considered alone or in combination, disclose, teach, or suggest the unique container capacitor structure comprising an electropolished patterned metal layer as recited by claims 55 and 60.

The Office Action states that Figure 5 of Xing discloses a “lower electrode comprising an electropolished patterned metal layer having a bottom wall and vertical sidewalls extending rectangularly upwardly therefrom,” as recited in claim 55; as well as, “a plurality of rectangular openings providing in said insulating layer, as recited in claim 60. Xing teaches that “FIG. 5 illustrates a fourth preferred embodiment crown cell capacitor . . . similar to that of FIG. 2.” (Col. 6, lines 51-52). The capacitor illustrated in Xing’s Figure 2, however, has a crown-type cell configuration with characteristics different from those of the container-type capacitor of the claimed invention. The capacitors illustrated in Figures 2 and 5 of Xing have a big solid bottom electrode (204 of Figure 2 and 504 of Figure 5) that requires etching.

Therefore, the etched thick bottom electrodes 204 and 504 of Figures 2 and 5 of Xing could not correspond to the thin electropolished metal layer of the claimed invention; specifically, the metal layer having a thickness of approximately 50 to 300 Angstroms, as in the claimed invention. Alternatively, the Office Action relies upon Figure 3 of Xing as disclosing a metal layer having a thickness of approximately 100-500 angstroms. Figure 3 of Xing, however, discloses that the capacitor electrode 304 has vertical sidewalls that form an obtuse angle with the bottom of the capacitor and do not extend “rectangularly upwardly therefrom,” as recited in claim 55. Additionally, Figure 3 does not disclose a capacitor comprising “rectangular openings” as recited in claim 60. Accordingly, Xing fails to disclose or suggest every limitation of claims 55 and 60.

Applicant respectfully submits that the claimed invention relates to an electropolished patterned metal layer formed as part of a semiconductor device, as recited in claims 55 and 60. The Office Action notes that the process limitation of forming an electro-polished patterned metal layer would not carry patentable weight in this claim drawn to a structure, because a distinct structure is not necessarily produced.

Applicant respectfully reaffirms that the limitation “electropolished patterned metal layer” is not a product-by-process limitation, but rather a *resulting structure* having distinct and defined characteristics. Specifically, the term “electropolished patterned” describes the physical characteristics of the metal layer. Applicant respectfully submits that it is well known in the art that electropolishing results in smoother surfaces with less damage than other conventional polishing techniques, such as chemical mechanical polishing. Therefore, an electropolished metal layer has distinct characteristics as compared to metal layers polished or etched by other means. Claim limitations which confer distinct and defined characteristics of a structure have been analyzed by the Federal Circuit in Hazani v. U.S. Int’l Trade

Comm'n, for example. Hazani v. U.S. Int'l Trade Comm'n, 126 F.3d 1473, 44 USPQ2d 1358 (Fed. Cir. 1997). An "electropolished patterned metal layer," like the "chemically engraved" plate of Hazani, is a *resulting structure* having distinct and defined characteristics and not a product formed by a particular process. See also MPEP §2113 citing In re Garnero, 412 F.2d 276, 279, 162 USPQ 221, 223 (CCPA 1979) (holding that "interbonded by diffusion" was a structural limitation, and further holding that terms such as "welded," "intermixed," "ground in place," "press fitted" and "etched" can be considered structural limitations).

Accordingly, the limitation "electropolished patterned metal layer," as recited in claims 55 and 60, is not a product-by-process limitation, but rather a *resulting structure* having distinct and defined characteristics. Specifically, the term "electropolished patterned" describes the metal layer having smoother surfaces with less damage than other conventional polishing techniques, such as chemical mechanical polishing. Therefore, Applicant respectfully submits that the electropolished patterned metal layer of claims 55 and 60 is a distinct structure with defined characteristics.

The Office Action also notes that Aoki teaches in Figure 6 the forming of a capacitor bottom electrode 38 by using an electropolishing method for reducing the leakage current of the capacitor. Applicant respectfully submits that Aoki fails to cure the deficiencies of Xing and thus, the combination fails to disclose or suggest every limitation recited in claims 55 and 60.

Aoki discloses a process of electropolishing an already patterned metal layer. Specifically, the convex parts 38a and 38b form a saw-toothed shape on the surface of the bottom electrode 38. (Col. 4, lines 11-13). The convex parts pointed end 38a is very finely polished uniformly by dissolving according to electropolishing. (Abstract). After the electropolishing process, the convex part pointed end 38a becomes flattened into a

spherical curved surface in which the radius of curvature has been enlarged is formed. (Abstract, col. 4, lines 15-20). Additionally, a high-dielectric film 40 of BSTO is laminated on the bottom electrode 38 and thus flattened according to a sputtering method. (col. 4, lines 23-26).

As shown in Figure 6, Aoki discloses a planar capacitor with its bottom electrode 38 subjected to a flattening process. Aoki fails to disclose or suggest a "container capacitor" with its bottom electrode comprising an electropolished patterned metal layer having a bottom and vertical sidewalls extending upwardly from said bottom, as recited in claim 55. Aoki also fails to disclose or suggest a "container capacitor" comprising a plurality of rectangular openings and bottom electrodes provided along the bottom and sidewalls of respective rectangular openings, as recited in claim 60. As such, Aoki and the combination of Xing and Aoki fails to disclose or suggest every limitation of claims 55 and 60.

In addition, Applicant respectfully submits that it would not have been obvious to one of ordinary skill in the art to combine Aoki and Xing to produce the exemplary inventions of claims 55 and 60. Xing specifically relates to a "high-selectivity via etching process" that "includes the steps of: forming an etchstop layer 840 ...; forming a dielectric layer over the etchstop layer; and etching the dielectric layer with a fluorine-bearing etchant." (Abstract). Xing also discloses a storage type capacitor. Aoki, on the other hand, discloses convex parts 38a and 38b forming a saw-toothed shape on the surface of the bottom electrode 38, and a planar capacitor. Even if the electropolishing method of Aoki was used to produce the metal layer structure of Xing, it would not have produced the exemplary structure of an electropolished patterned metal layer having a bottom wall and vertical sidewalls extending rectangularly upwardly therefrom, as recited in claim 55, or the electropolished patterned metal layer provided along rectangular openings, as recited in claim 60.

Applicant respectfully submits that neither Xing nor Aoki, whether considered alone or in combination, teach or suggest all of the limitations of claims 55 and 60. Thus, claims 55 and 60 are allowable over the combination of the Xing and Aoki. Claims 56-58 depend from claim 55 and are allowable along with claim 55. Claims 61-64 depend from claim 60 and are allowable along with claim 60. Applicant respectfully requests the withdrawal of the rejection and allowance of the claims.

Claims 36-39, 41, 44-47, 49, 51-54 and 59 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Xing et al. (U.S. Patent No. 6,090,697) in view of Aoki et. al. (U.S. Patent No. 6,033,953) and further in view of Huang (U.S. Patent No. 6,127,260). The rejection is respectfully traversed.

Claim 36 recites “[a] memory cell comprising ... an electropolished patterned metal layer within an insulating layer provided over said substrate, said electropolished patterned metal layer having a thickness of about 50 to about 300 Angstroms; and a container capacitor including a lower electrode, a dielectric layer over said lower electrode, and an upper electrode over said dielectric layer, said upper electrode comprising doped polysilicon, said lower electrode having a surface aligned over said source/drain region, said electropolished patterned metal layer forming said lower electrode, and said dielectric layer being in contact with said insulating layer.”

Claim 44 recites “[a] processor-based system comprising: a processor; and an integrated circuit coupled to said processor, at least one of said integrated circuit and processor comprising a container capacitor provided within an insulating layer, said container capacitor including a lower electrode and an upper electrode, said lower electrode comprising an electropolished patterned metal layer having a thickness of approximately 50 to 300 Angstroms, wherein a top surface of said electropolished

patterned metal layer is at the same level with a top surface of said insulating layer, said upper electrode comprising doped polysilicon.”

Claim 59 recites “[a] container capacitor provided within an opening of an insulating layer of a substrate comprising: a tantalum nitride barrier conductive layer provided at a bottom of said opening; a lower electrode provided over said tantalum nitride barrier conductive layer, said lower electrode comprising an electropolished patterned metal layer having a bottom and vertical sidewalls extending upwardly from said bottom, said lower electrode having a thickness of approximately 100 Angstroms; a dielectric material provided over said electropolished patterned metal layer and in contact with said insulating layer; and an upper electrode comprising doped polysilicon provided over said dielectric material and wherein said lower electrode, said dielectric material and said upper electrode form a container capacitor.” Applicant respectfully submits that none of the references of record, whether considered alone or in combination, disclose, teach, or suggest the unique container capacitor structure comprising an electropolished patterned metal layer as recited by claims 36, 44, and 59.

Applicant respectfully submits that the claimed invention relates to an electropolished patterned metal layer formed as part of a semiconductor device, as recited in claims 36, 44, and 59. The Office Action notes that the process limitation of forming an electro-polished patterned metal layer would not carry patentable weight in this claim drawn to a structure, because a distinct structure is not necessarily produced. As discussed above, the limitation “electropolished patterned metal layer” is not a product-by-process limitation, but rather a *resulting structure* having distinct and defined characteristics. Specifically, the term “electropolished patterned” describes the metal layer having smoother surfaces with less damage than other conventional polishing techniques, such as chemical mechanical polishing. Therefore, Applicant

respectfully submits that the electropolished patterned metal layer of claims 36, 44, and 59 is a distinct structure with defined characteristics.

The Office Action correctly states that Xing does not teach an upper electrode comprising doped silicon, as recited in claims 36, 44, and 59. Huang is relied upon to fill this deficiency. Nevertheless, neither Xing nor Huang disclose or suggest an electropolished patterned metal layer within an insulating layer, as recited by claims 36, 44, and 59.

The Office Action relies on Aoki for teaching in Figure 6 the forming of a capacitor bottom electrode 38 by using an electropolishing method for reducing the leakage current of the capacitor. As previously discussed above, Aoki discloses a process of electropolishing an already patterned metal layer. Specifically, the convex parts 38a and 38b form a saw-toothed shape on the surface of the bottom electrode 38. (Col. 4, lines 11-13). As shown in Figure 6, Aoki discloses a planar capacitor with its bottom electrode 38 subjected to a flattening process. Aoki fails to disclose, teach, or suggest the limitation of a container capacitor including a lower electrode formed by an electropolished patterned metal layer, as recited in claim 36. Aoki also fails to disclose, teach, or suggest the limitation of a container capacitor including a lower electrode comprising an electropolished patterned metal layer, as recited in claims 44 and 59.

The combination of Xing, Aoki, and Huang would not have produced a container capacitor comprising the exemplary structure of an electropolished patterned metal layer within an insulating layer, as recited in claims 36, 44, and 59. Accordingly, claims 36, 44, and 59 are allowable over the combination of the Xing, Aoki and Huang. Claims 37-39 and 41 depend from claim 36 and are allowable along with claim 36. Claims 45-47, 49, and 51-54 depend from claim 44 and are allowable along with claim

44. Applicant respectfully requests the withdrawal of the rejection and allowance of the claims.

In view of the above amendment, applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

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